Household Groupings

We grouped households into: (i) three groups of the age of the main shopper (18-44; 45-64; 65+ years); (ii) four occupation-based social grade groups (AB ('highest'), C1, C2, DE ('lowest')) based on the National Readership Survey;[1] (iii) four similar sized household income groups (£0–8.75k; >£8.75–15k; >£15–22.5k; and >£22.5k per adult per household per year); (iv) four similar sized groups of the number of grams of all alcohol regularly purchased (>0–7; >7–21; >21–70; and >70 g of alcohol purchased per adult per household per week, averaged over the total number of days between first and last recorded day of an alcohol purchase at the household level); (v) four similar sized groups of area-based residential deprivation ranging from 1 (most deprived) to 4 (least deprived) based on multiple indices of ranking of residential deprivation aggregated at truncated postcode level for each of England,[2] Scotland,[3] and Wales;[4] and, (vi) based on truncated postcode, two groups of country (Scotland or Wales) and nine groups of regions of England (North East, North West, Yorkshire and The Humber, East Midlands, West Midlands, Eastern, London, South East, and South West).

1. National Readership Survey. Social Class London: National Readership Survey. 2019. Available online: http://www.nrs.co.uk/ nrs-print/lifestyle-and-classification-data/social-grade/ (accessed on 10 July 2019).

2. GOV.UK. National Statistics: English Indices of Deprivation 2019. Available online: https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019 (accessed on 22 March 2021).

3. Gov.scot. Scottish Index of Multiple Deprivation (SIMD) 2020 Technical Notes. 2020. Available online: https://www.gov.scot/publications/simd-2020-technical-notes/ (accessed on 21 March 2021).

4. Gov.Wales. Welsh Index of Multiple Deprivation (full Index update with ranks). 2019. Available online: https://gov.wales/welsh-index-multiple-deprivation-full-index-update-ranks-2019 (accessed on 30 August 2021).

Supplement Table 1 Alcohol by Volume (ABV) groups for each product category.

Product Group		ABV Classification
Beer	No-alcohol	0%
	Low alcohol	>0.0% and ≤3.5%
	Regular	>3.5%
Cider	No-alcohol	0%
	Low alcohol	>0.0% and ≤3.5%
	Regular	>3.5%
Wine	No-alcohol	0%
	Low alcohol	>0.0% and ≤8.5%
	Regular	>8.5%
Spirits	No-alcohol	0%
	Low alcohol	>0.0% and ≤15%
	Regular	>15%
Fortified wines and liqueurs	No-alcohol	0%
	Low alcohol	>0.0% and ≤15%
	Regular	>15%
Ready-to-drink (RTD)	No-alcohol	0%
	Low alcohol	>0.0% and ≤3.5%
	Regular	>3.5%

Interrupted Time Series Analyses

We use ARIMA modelling to estimate the standardized coefficients and 95% confidence intervals for the associations of changes over time between four independent variables (standardized values of purchases of volume of zero-alcohol product, of low-alcohol product, and of all other regular strength products, and ABV of purchased regular strength products) and the dependent variable, standardized values of purchases of grams of alcohol within beer, wine or spirits, depending on the household cluster.

We analyse longitudinal data by household. To consider any cohort effect (that is, households joining the panel in 2019 may differ from households joining in 2015 with respect to alcohol purchases), we used the first recorded day of an alcohol purchase as an independent covariate in the model.

We repeat the ARIMA models separately for each country (Scotland and Wales) and for each of the nine regions of England.

We undertake two sensitivity analyses:

i. We repeat the ARIMA model for all Great Britain, restricting the analyses to the years 2017 to 2019, considering that purchases of no- and low-alcohol products might have increased over time.
ii. We repeat the ARIMA model for all Great Britain, separately for the years 2015 to 2019 restricting the analyses to the first 365 days of follow-up for each year to consider any cohort effect (that is, all else being equal, households joining the panel in 2019 may differ from households joining in 2015, with respect to purchases of alcohol).

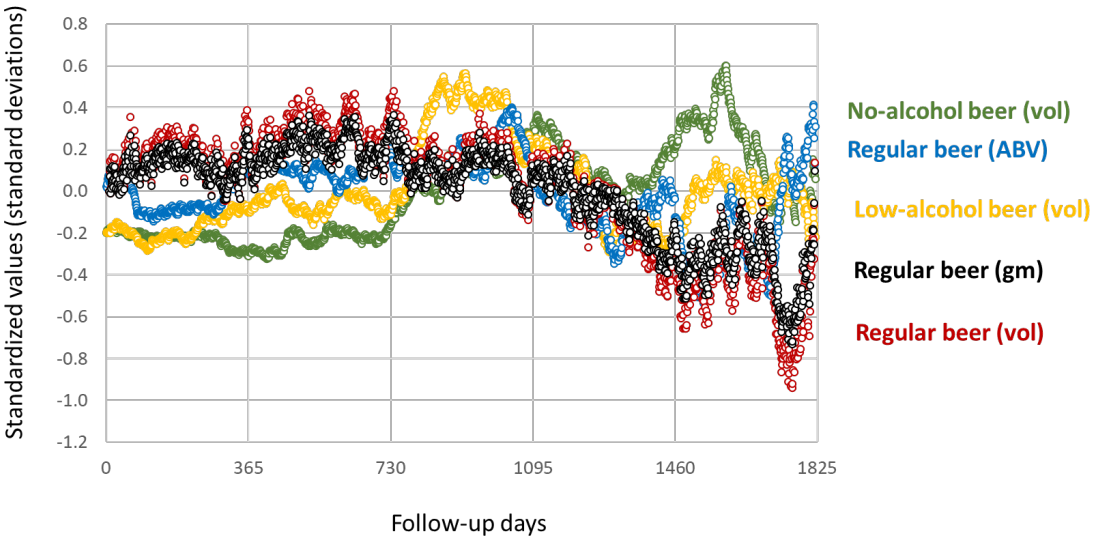
To consider the potential impact of changes in price on volumes purchased, we also run ARIMA models with volume purchased as the dependent variable and price paid per volume as the independent variable.

Beer Households

Supplement Figure 1 plots (standardized values) by follow-up (days):

- **Independent variables:**
  i. Purchases of volume of zero-alcohol beer, with ABV=0.0%
  ii. Purchases of volume of low-alcohol beer, with ABV=>0.0% and ≤3.5%
  iii. Purchases of volume of all other beer, with an ABV>3.5%
  iv. ABV of purchased beer with an ABV > 3.5%
- **Dependent variables:**
  i. Purchases of grams of alcohol within beer

There is no indication of seasonal variation, which is not unexpected, since, for each household, the first follow-up day is a different day of the week and day of the year.

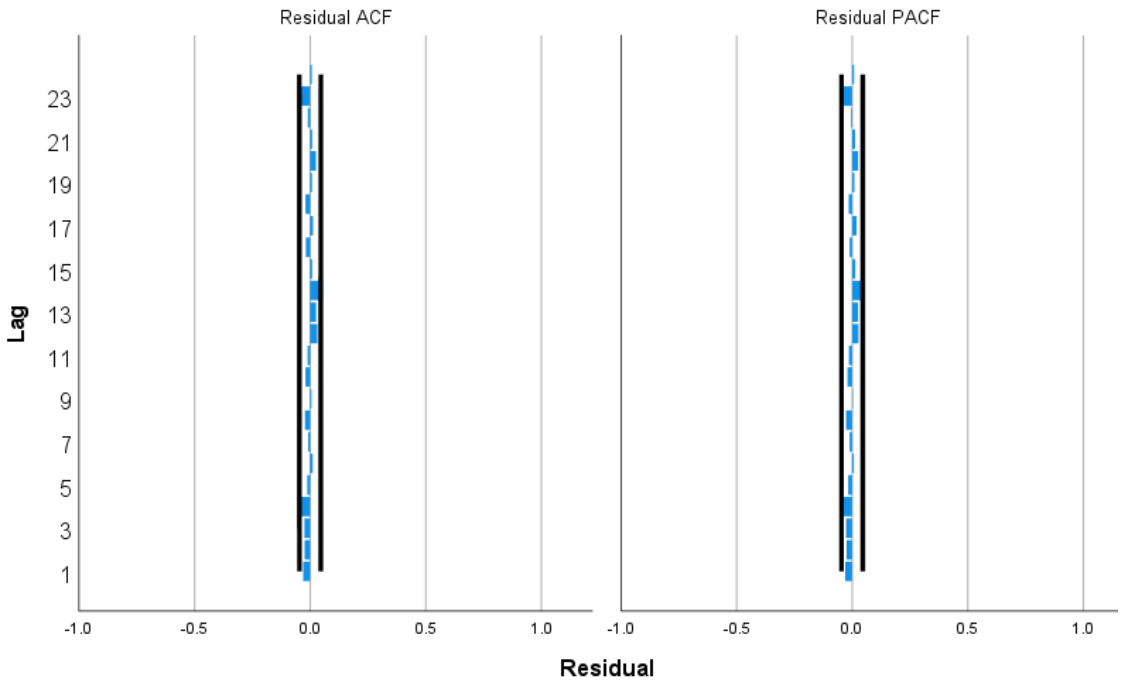


Supplement Figure 1. Mean standardized values of beer purchases across all beer-cluster households by number of days of follow-up.

We used a time series modeler function that specifies degrees of differencing and/or a square root or natural log transformation to ensure a stationary series and that specifies autoregressive and moving average orders to estimate the best fitting ARIMA model. The resultant model type (4,0,4) has four time lags of the autoregressive model, no non-seasonal differences needed for stationarity, and four orders of the moving average model in the prediction equation, with stationary $R^2 = 0.993$, and values of residual ACF and PACF plotted in Supplement Figure 2. The regression equation for the ARIMA model is:

$$(1-\phi_1 B-\phi_2 B-\phi_3 B-\phi_4 B)Y_t = \beta_{intercept} + (1-\theta_1 B-\theta_2 B-\theta_3 B-\theta_4 B)\alpha_t + \beta_{zero}(1-\phi_1 B-\phi_2 B-\phi_3 B-\phi_4 B)Z_t + \beta_{low}(1-\phi_1 B-\phi_2 B-\phi_3 B-\phi_4 B)L_t + \beta_{reg}(1-\phi_1 B-\phi_2 B-\phi_3 B-\phi_4 B)R_t + \beta_{abv}(1-\phi_1 B-\phi_2 B-\phi_3 B-\phi_4 B)A_t + \beta_{day1}(1-\phi_1 B-\phi_2 B-\phi_3 B-\phi_4 B)D1_t.$$

Where Y_t is the dependent variable at day t; $\phi_{1\ to}\ \phi_4$ are the non-seasonal autoregressive operators at lags 1 to 4; B is the backshift operator; $\beta_{intercept}$ is the intercept, θ_1 to θ_4 are the non-seasonal moving average operators at lag 1 through to lag 4; α_t is the error term; β_{zero} is the impact of zero alcohol beer; Z_t is zero alcohol beer at time t; β_{low} is the coefficient of low alcohol beer; L_t is low-alcohol beer at time t; β_{reg} is the coefficient of regular beer (ABV>3.5%); R_t is regular beer at time t; β_{abv} is the coefficient of the ABV of regular beer (ABV>3.5%); A_t is the ABV of regular beer at time t; β_{day1} is the coefficient of the first day of purchase; D1 is the first day of purchase at time t.



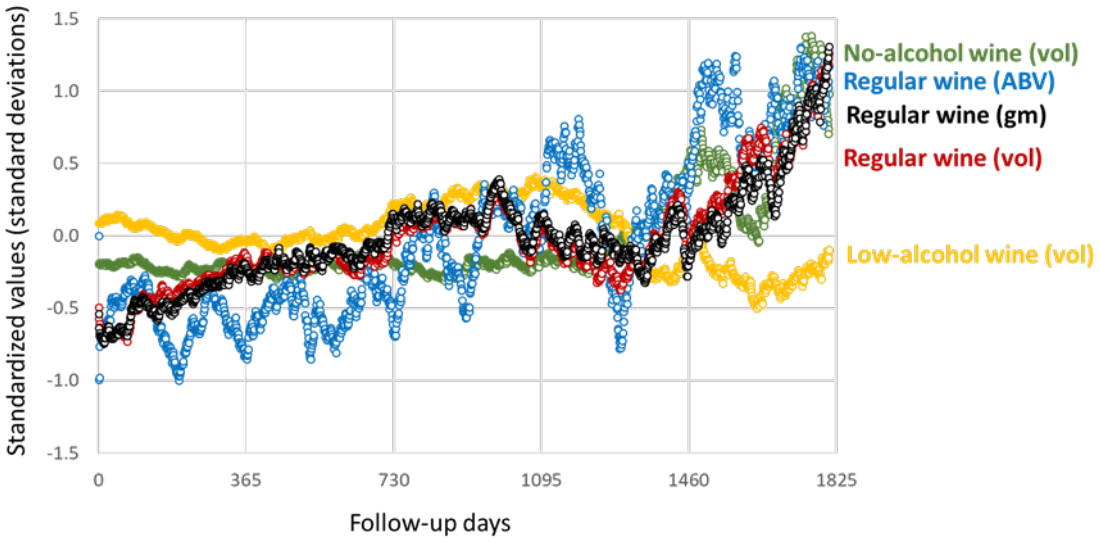
Supplement Figure 2. Plots of residual autocorrelation function (ACF) and partial autocorrelation function (PACF) of the series of the dependent variable (standardized value of purchases of grams of alcohol within beer) from ARIMA model (4,0,4).

Wine Households

Supplement Figure 3 plots (standardized values) by follow-up (days):

- **Independent variables:**
  - v. Purchases of volume of zero-alcohol wine, with ABV=0.0%
  - vi. Purchases of volume of low-alcohol wine, with ABV=>0.0% and ≤8.5%
  - vii. Purchases of volume of all other wine, with an ABV>8.5%
  - viii. ABV of purchased wine with an ABV > 8.5%
- **Dependent variables:**
  - ii. Purchases of grams of alcohol within wine

There is no indication of seasonal variation, which is not unexpected, since, for each household, the first follow-up day is a different day of the week and day of the year.



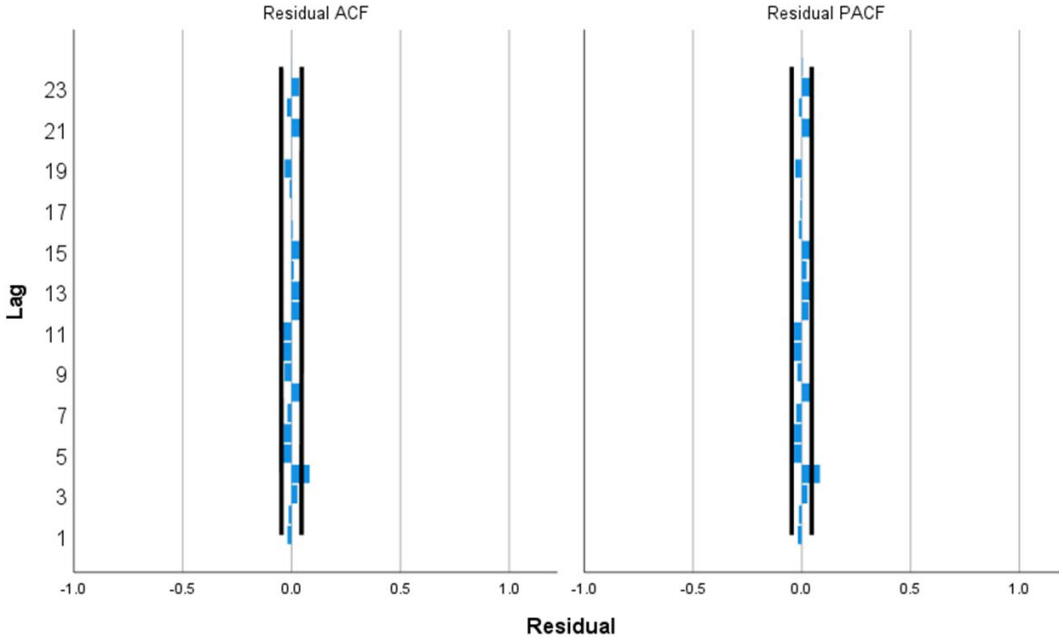
Supplement Figure 3 Mean standardized values of wine purchases across all wine-cluster households by number of days of follow-up.

We used a time series modeler function that specifies degrees of differencing and/or a square root or natural log transformation to ensure a stationary series and that specifies autoregressive and moving average orders to estimate the best fitting ARIMA model. The resultant model type (1,0,4) has one time lag of the autoregressive model, no non-seasonal differences needed for stationarity, and four orders of the moving average model in the prediction equation, with stationary $R^2 = 0.879$, and values of residual ACF and PACF plotted in Supplement Figure 4. The regression equation for the ARIMA model is:

$$(1\text{-}\phi_1 B)Y_t = \beta_{intercept} + (1\text{-}\theta_1 B\text{-}\theta_2 B\text{-}\theta_3 B\text{-}\theta_4 B)\alpha_t + \beta_{zero}(1\text{-}\phi_1 B)Z_t + \beta_{low}(1\text{-}\phi_1 B)L_t + \beta_{reg}(1\text{-}\phi_1 B)R_t + \beta_{abv}(1\text{-}\phi_1 B)A_t + \beta_{day1}(1\text{-}\phi_1 B)D1_t.$$

Where Y_t is the dependent variable at day *t;* ϕ_1 is are the non-seasonal autoregressive operator at lag 1; B is the backshift operator; $\beta_{intercept}$ is the intercept, θ_1 to θ_4 are the non-seasonal moving average operators at lag 1 through to lag 4; α_t is the error term; β_{zero} is the impact of zero alcohol wine; Z_t is zero alcohol wine at time t; β_{low} is the coefficient of low alcohol wine; L_t is low-alcohol wine at time t; β_{reg} is the coefficient of regular wine (ABV>8.5%); R_t is regular wine at time t; β_{abv}

is the coefficient of the ABV of regular wine (ABV>8.5%); A_t is the ABV of regular wine at time t; β_{day1} is the coefficient of the first day of purchase; D1 is the first day of purchase at time t.



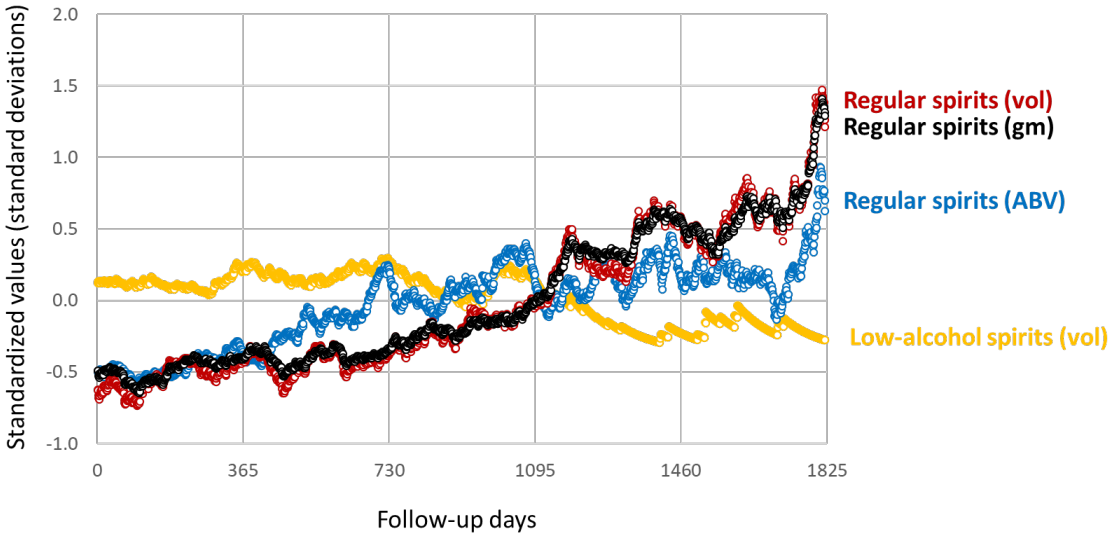
Supplement Figure 4. Plots of residual autocorrelation function (ACF) and partial autocorrelation function (PACF) of the series of the dependent variable (standardized value of purchases of grams of alcohol within wine) from ARIMA model (1,0,4).

Spirits Households

Supplement Figure 5 plots (standardized values) by follow-up (days):

- **Independent variables:**
  - ix. Purchases of volume of low-alcohol spirits, with ABV=>0.0% and ≤15%
  - x. Purchases of volume of all other spirits, with an ABV>15%
  - xi. ABV of purchased spirits with an ABV > 15%
- **Dependent variables:**
  - iii. Purchases of grams of alcohol within spirits

There is no indication of seasonal variation, which is not unexpected, since, for each household, the first follow-up day is a different day of the week and day of the year.

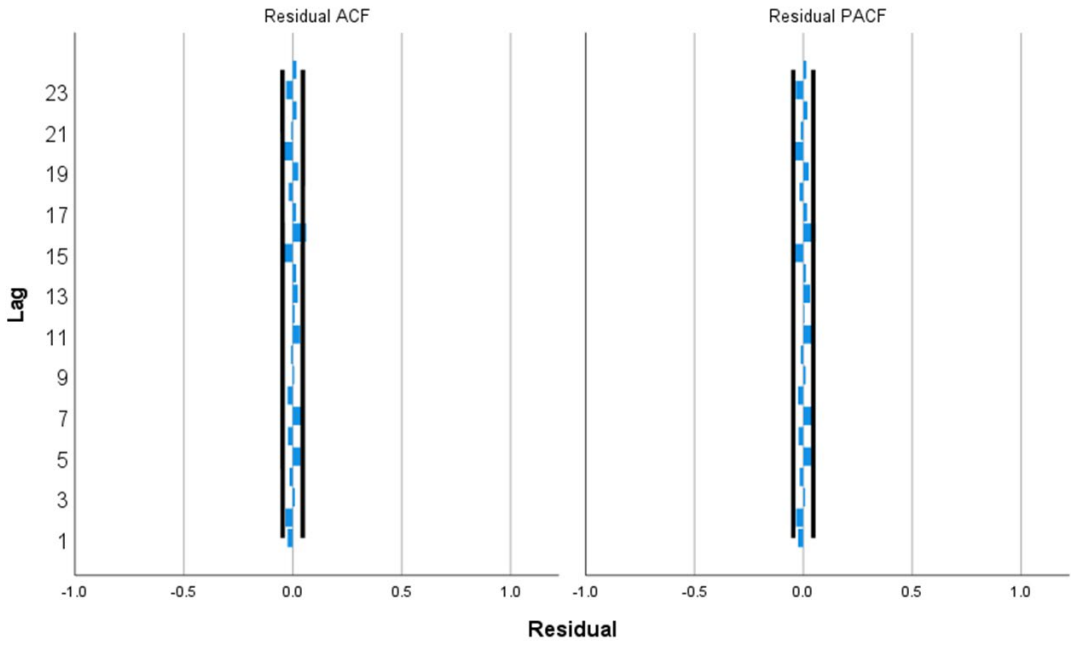


Supplement Figure 5 Mean standardized values of spirits purchases across all spirit-cluster households by number of days of follow-up.

We used a time series modeler function that specifies degrees of differencing and/or a square root or natural log transformation to ensure a stationary series and that specifies autoregressive and moving average orders to estimate the best fitting ARIMA model. The resultant model type (1,0,1) has one time lag of the autoregressive model, no non-seasonal differences needed for stationarity, and one order of the moving average model in the prediction equation, with stationary $R^2 = 0.952$, and values of residual ACF and PACF plotted in Supplement Figure 6. The regression equation for the ARIMA model is:

$$(1\text{-}\phi_1 B)Y_t = \beta_{intercept} + (1\text{-}\theta_1 B)\alpha_t + \beta_{low}(1\text{-}\phi_1 B)L_t + \beta_{reg}(1\text{-}\phi_1 B)R_t + \beta_{abv}(1\text{-}\phi_1 B)A_t + \beta_{day1}(1\text{-}\phi_1 B)D1_t.$$

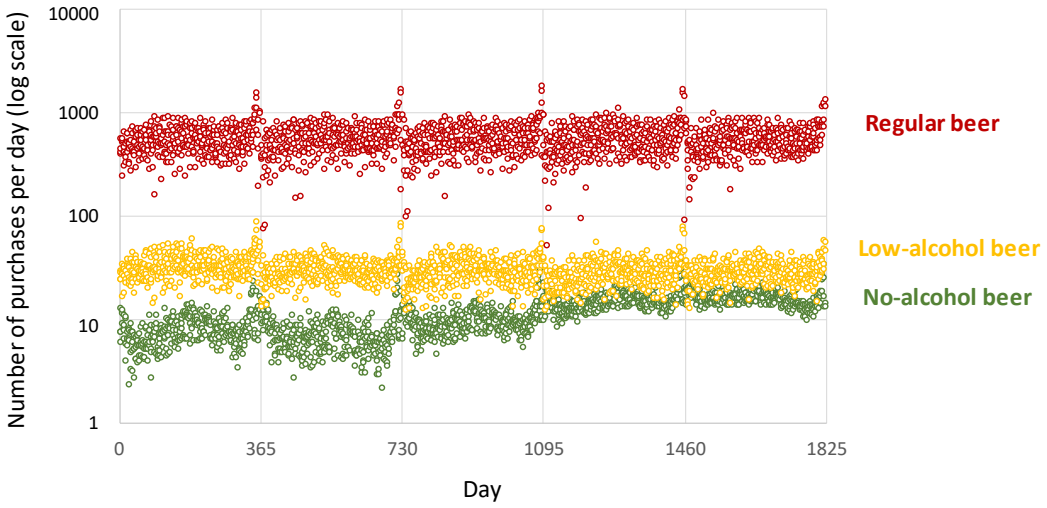
Where Y_t is the dependent variable at day t; ϕ_1 is are the non-seasonal autoregressive operator at lag 1; B is the backshift operator; $\beta_{intercept}$ is the intercept, θ_1 is the non-seasonal moving average operator at lag 1; α_t is the error term; β_{low} is the coefficient of low alcohol spirits; L_t is low-alcohol spirits at time t; β_{reg} is the coefficient of regular spirits (ABV>15%); R_t is regular spirits at time t; β_{abv} is the coefficient of the ABV of regular spirits (ABV>15%); A_t is the ABV of regular spirits at time t; β_{day1} is the coefficient of the first day of purchase; D1 is the first day of purchase at time t.



Supplement Figure 6. Plots of residual autocorrelation function (ACF) and partial autocorrelation function (PACF) of the series of the dependent variable (standardized value of purchases of grams of alcohol within spirits) from ARIMA model (1,0,1).

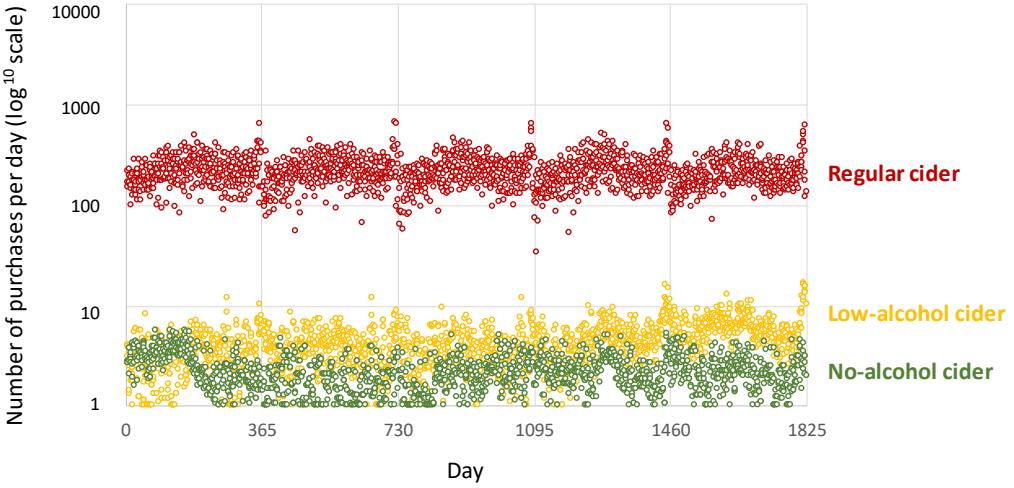
Supplement Table 2 Number (and per cent) of purchases over whole time period (2015-2019) by Alcohol by Volume (ABV) group within product group.

Product Group	ABV Group	Number of separate purchases	Per cent of purchases within product group
Beer	0%	19968	1.9
	>0.0% and ≤3.5%	53161 (of which 2679 >0.0% and ≤0.5%)	5.0 (of which 0.25 >0.0% and ≤0.5%)
	>3.5%	996874	93.2
	Total	1070003	100.0
Cider	0%	7574	1.9
	>0.0% and ≤3.5%	3099 (of which 847 >0.0% and ≤0.5%)	.8 (of which 0.21 >0.0% and ≤0.5%)
	>3.5%	395664	97.4
	Total	406337	100.0
Wine	0%	1567	0.1
	>0.0% and ≤8.5%	111734 (of which 4225 >0.0% and ≤3.5%)	6.2 (of which 0.24 >0.0% and ≤0.5%)
	>8.5%	1679938	93.7
	Total	1793239	100.0
Spirits	0%	0	0.0
	>0.0% and ≤15%	1053 (of which 0 >0.0% and ≤3.5%)	0.2
	>15%	445089	99.8
	Total	446142	100.0
Fortified wines and liqueurs	0%	166	0.1
	>0.0% and ≤15%	82685 (of which 0 >0.0% and ≤3.5%)	37.6
	>15%	136790	62.3
	Total	219641	100.0
Ready-to-drink (RTD)	0%	60	0.0
	>0.0% and ≤3.5%	2514 (of which 666 >0.0% and ≤0.5%)	1.9 (of which 0.51 >0.0% and ≤0.5%)
	>3.5%	129279	98.0
	Total	131853	100.0



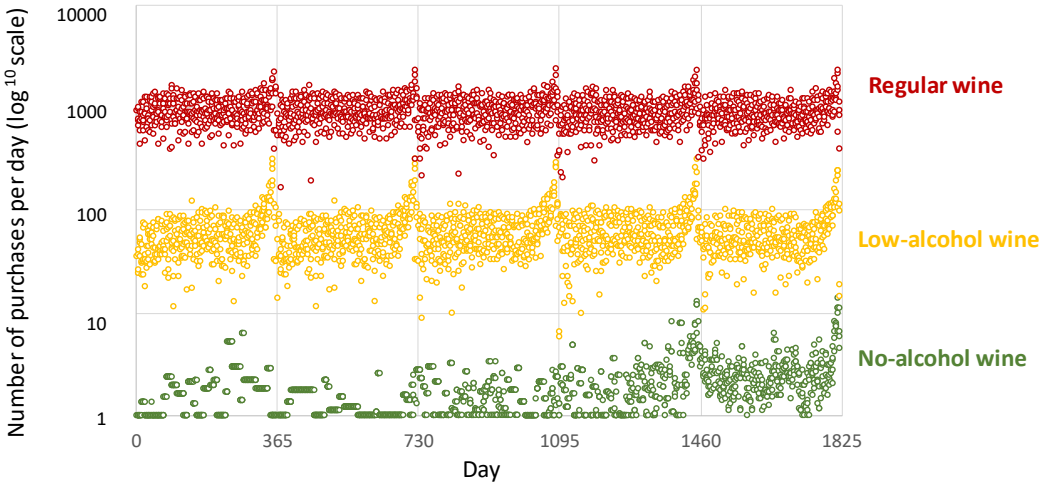
Supplement Figure 7. Plots of number of separate purchases (log^{10} scale) of beers by ABV group summed across all households for each calendar day, where day 1 = 1st January 2015 and day 1826 = 31st December 2019.

No-alcohol	0%
Low alcohol	>0.0% and ≤3.5%
Regular	>3.5%



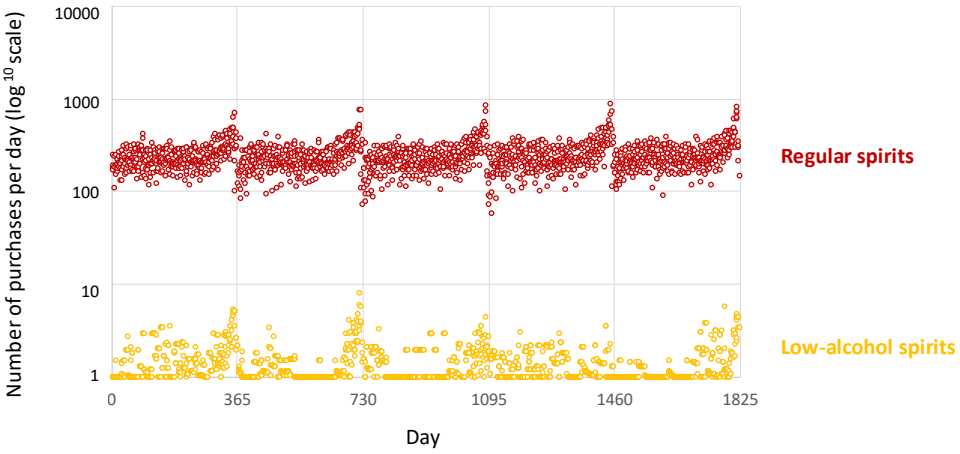
Supplement Figure 8. Plots of number of separate purchases (log^{10} scale) of ciders by ABV group summed across all households for each calendar day, where day 1 = 1st January 2015 and day 1826 = 31st December 2019.

No-alcohol	0%
Low alcohol	>0.0% and ≤3.5%
Regular	>3.5%



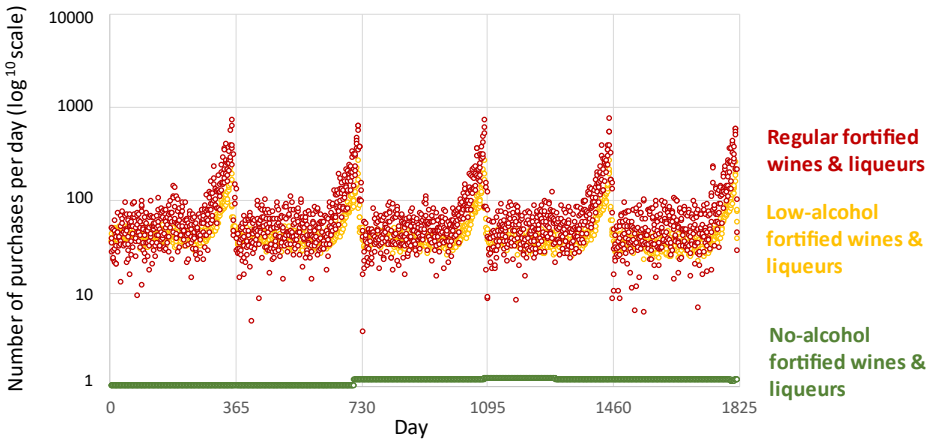
Supplement Figure 9. Plots of number of separate purchases (log^{10} scale) of wines by ABV group summed across all households for each calendar day, where day 1 = 1st January 2015 and day 1826 = 31st December 2019.

No-alcohol	0%
Low alcohol	>0.0% and ≤8.5%
Regular	>8.5%



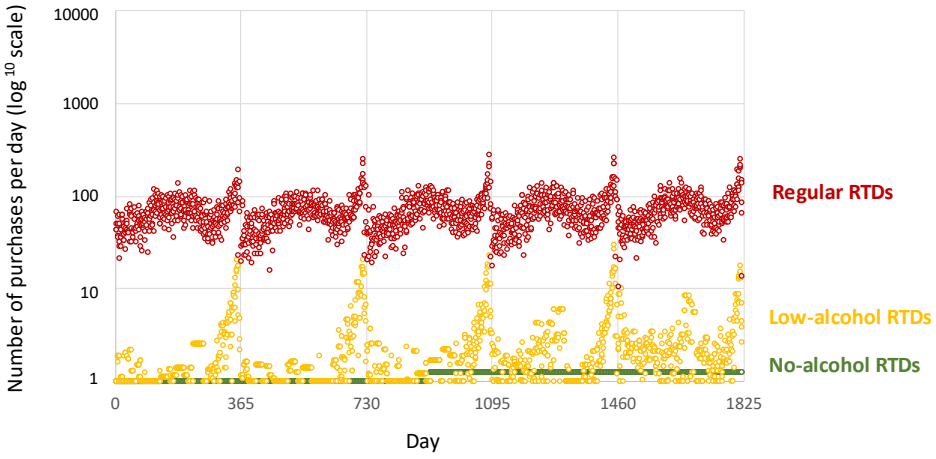
Supplement Figure 10. Plots of number of separate purchases (log^{10} scale) of spirits by ABV group summed across all households for each calendar day, where day 1 = 1st January 2015 and day 1826 = 31st December 2019.

No-alcohol	0%
Low alcohol	>0.0% and ≤15%
Regular	>15%



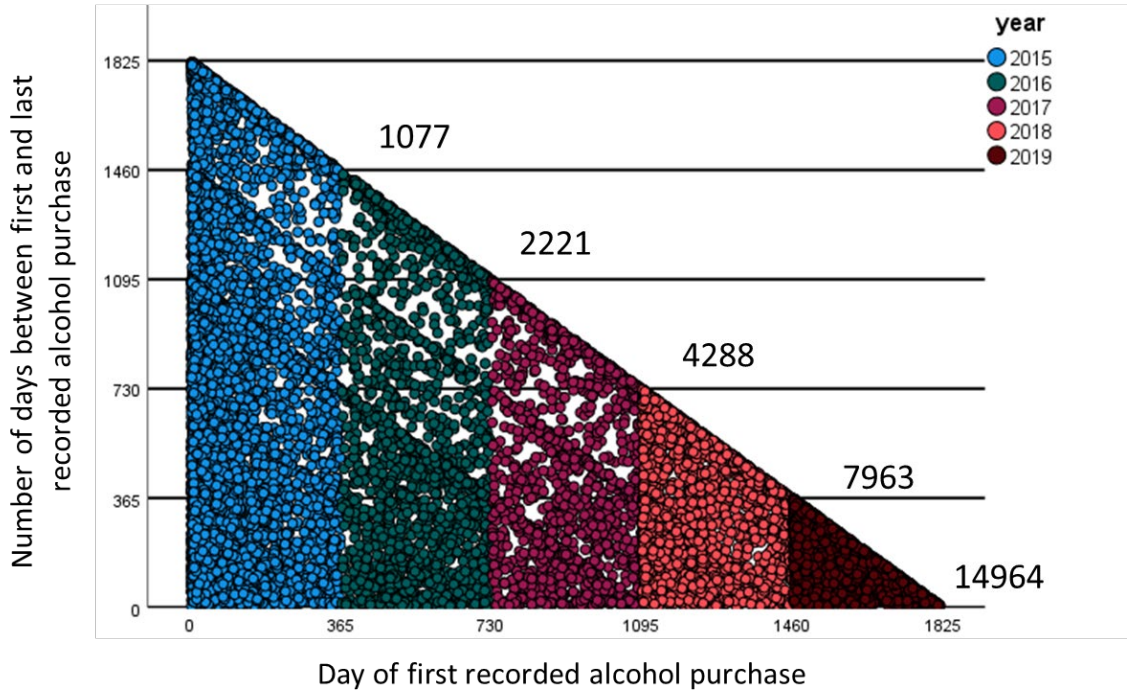
Supplement Figure 11. Plots of number of separate purchases (log^{10} scale) of fortified wines and liqueurs by ABV group summed across all households for each calendar day, where day 1 = 1st January 2015 and day 1826 = 31st December 2019.

No-alcohol	0%
Low alcohol	>0.0% and ≤15%
Regular	>15%

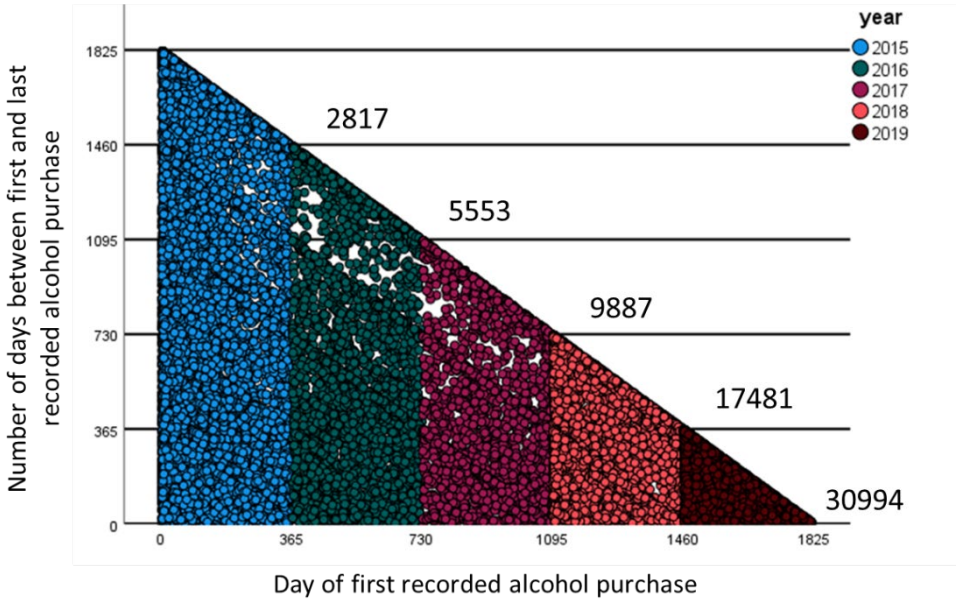


Supplement Figure 12. Plots of number of separate purchases (log^{10} scale) of ready-to-drinks (RTDs) by ABV group summed across all households for each calendar day, where day 1 = 1st January 2015 and day 1826 = 31st December 2019.

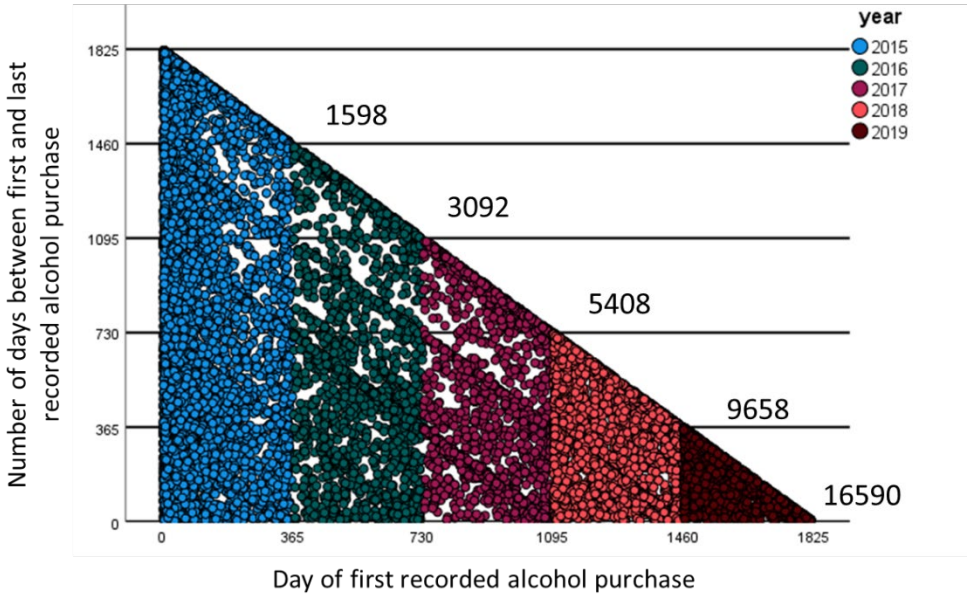
No-alcohol	0%
Low alcohol	>0.0% and ≤3.5%
Regular	>3.5%



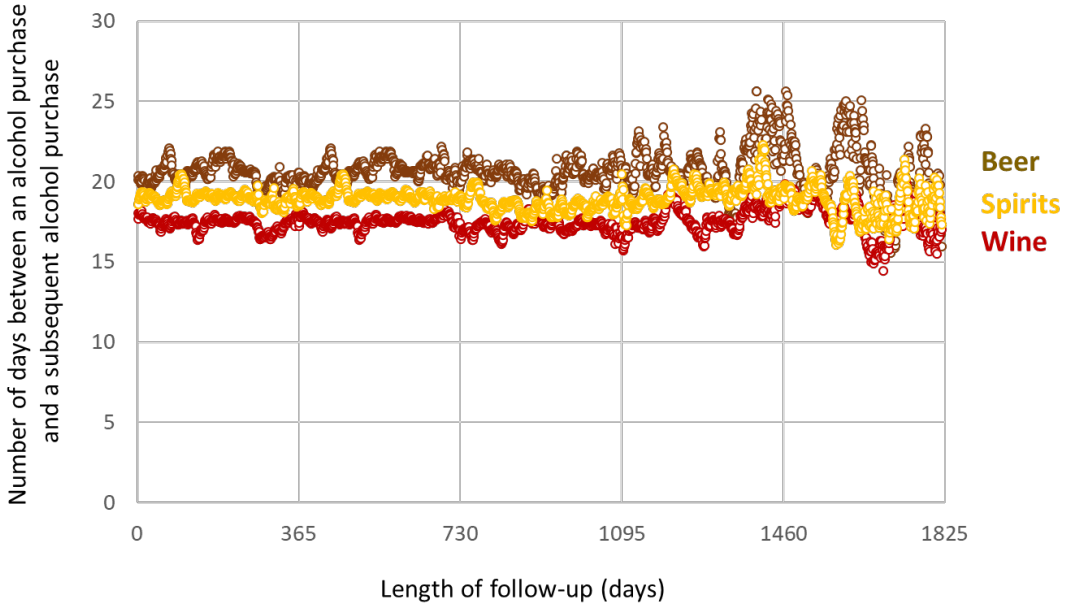
Supplement Figure 13. Plots of beer-cluster households, with number of days between first and last recorded alcohol purchase (i.e., length of follow-up) by day of first recorded alcohol purchase, colour-coded for calendar year of first recorded alcohol purchase. Numbers above each line indicate number of households providing data. Out of 14,964 households, 7963 households provided at least one years' follow-up data and 1077 Households (7.2% of all beer-cluster households) provided at least four years' follow-up of data. Dots are of one household.



Supplement Figure 14. Plots of wine-cluster households, with number of days between first and last recorded alcohol purchase (i.e., length of follow-up) by day of first recorded alcohol purchase, colour-coded for calendar year of first recorded alcohol purchase. Numbers above each line indicate number of households providing data. Out of 30994 households, 17481 households provided at least one years' follow-up data and 2817 Households (7.2% of all wine-cluster households) provided at least four years' follow-up of data. Dots are of one household.



Supplement Figure 15. Plots of spirits-cluster households, with number of days between first and last recorded alcohol purchase (i.e., length of follow-up) by day of first recorded alcohol purchase, colour-coded for calendar year of first recorded alcohol purchase. Numbers above each line indicate number of households providing data. Out of 16590 households, 9658 households provided at least one years' follow-up data and 1598 Households (7.2% of all spirits-cluster households) provided at least four years' follow-up of data. Dots are of one household.



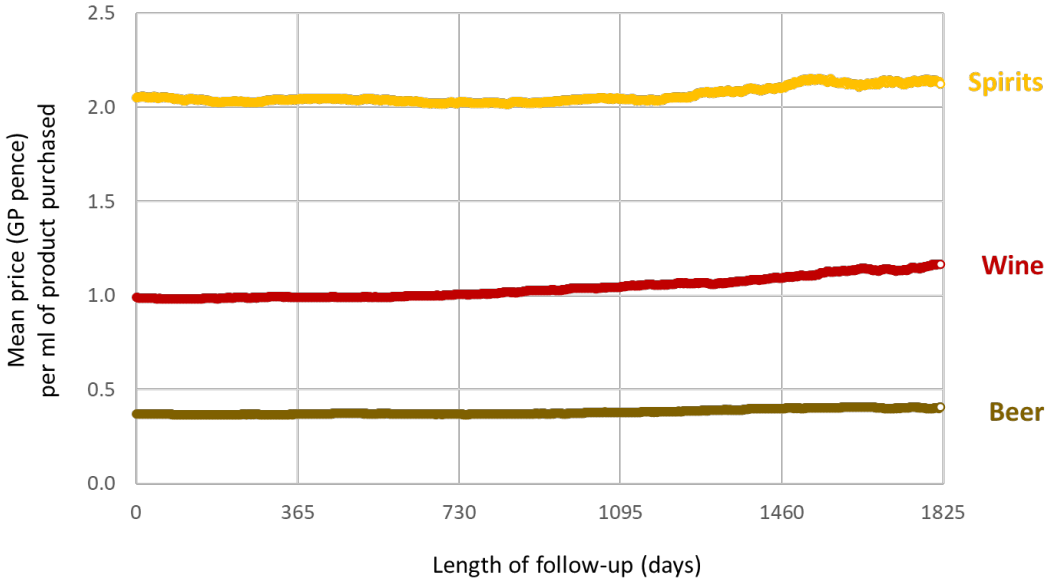
Supplement Figure 16. Plots of number of days between an alcohol purchase and a subsequent alcohol purchase (gap between purchases) by length of follow-up (days) for beer-cluster, wine-cluster and spirits-cluster households.

Across the whole time span, the gap between purchases was 20.6 days for beer-cluster households (95%CI, based on bootstrapping, n=1000, 20.5 to 20.7), 17.5 days (95%CI=17.4 to 17.6) for wine-cluster households, and 18.9 (95%CI=18.8 to 20.0) for spirits-cluster households. The difference between cluster of households was significant (beer:wine, mean difference=3.1 days (95%CI=3.0 to 3.2); beer:spirits, mean difference=1.7 days (95%CI=1.6 to 1.8); and, wine:spirits, 1.4 days (95%CI=1.3 to 1.5)).

Visual inspection indicates no change in the gap with length of follow-up. Linear regression, which includes 1825 data points, of the gap with days of follow-up found no change for beer-cluster households (coefficient = -8.5^{-5} (95%CI=-2.5^{-4} to 7.9^{-5}). For wine cluster households (coefficient = 1.2^{-4} (95%CI=1.0^{-5} to 2.6^{-4}), and spirits-cluster households (coefficient = 3.0^{-4} (95%CI=1.5^{-5} to 4.5^{-4}), the regression coefficients suggested tiny increases in the gap over the whole time period.

Potential impact of price on volumes of regular products purchased

Supplement Figure 17 plots the changes in mean price (GB pence) per ml of regular product purchased over time. ARIMA modelling, with volume purchased as the dependent variable and price as the independent variable found no associations over time.



Supplement Figure 17. Plots of mean price (GB pence) per ml of regular product purchased by length of follow-up (days) for beers, wines and spirits.